Better wind resource mapping with one click

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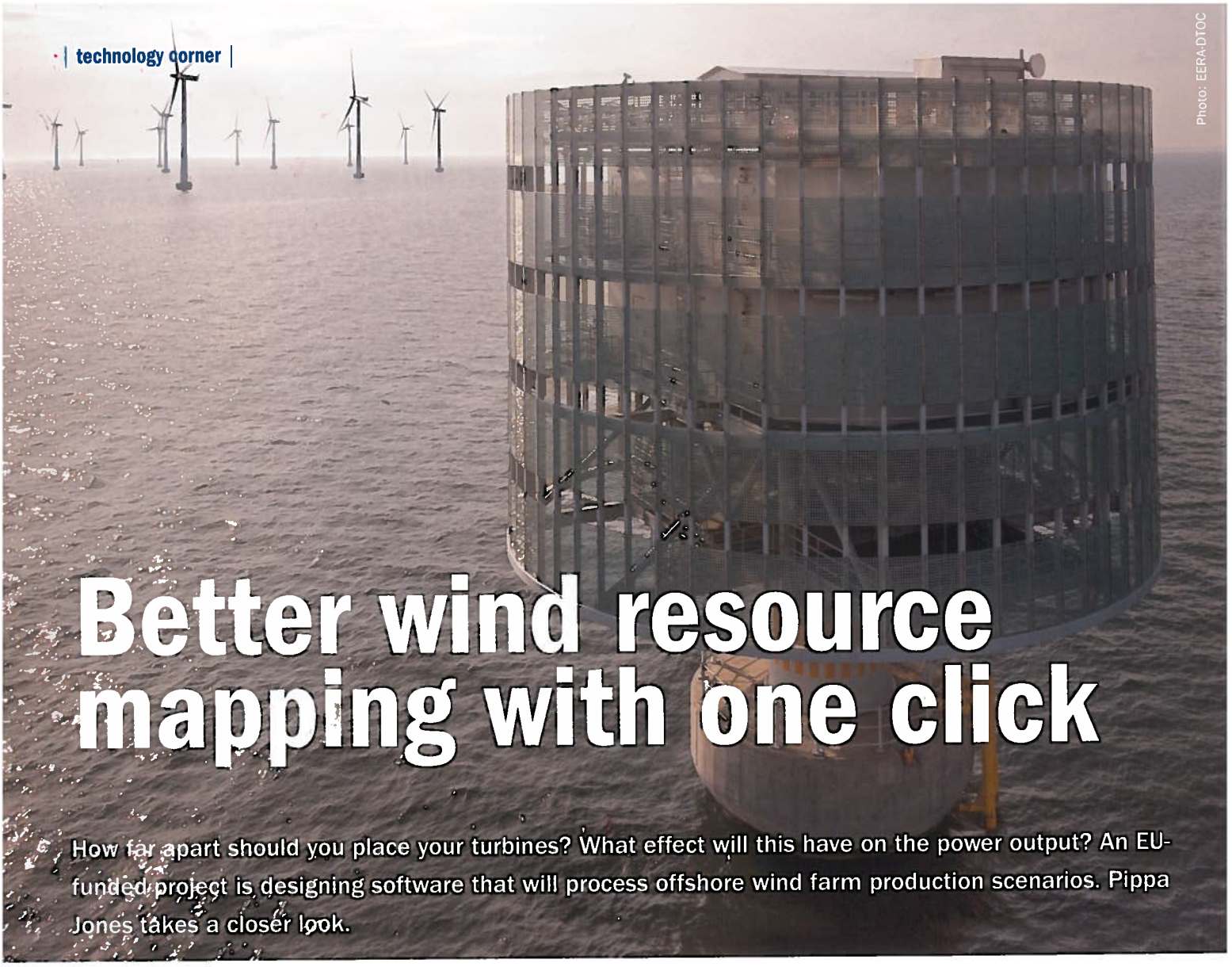

Photo: EERA-DTOC

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How far apart should you place your turbines? What effect will this have on the power output? An EU-funded project is designing software that will process offshore wind farm production scenarios. Pippa Jones takes a closer look.

The European offshore wind industry is growing. Indeed, new offshore capacity installations doubled during the first half of 2013 compared to the same period the previous year. However, there are still uncertainties surrounding the sector, not least a clear understanding of how best to plan offshore wind farms so that they produce as much power as possible. A recently set up EU-funded project is creating state-of-the-art software to generate data that will inject some solidity into this debate.

During the first six months of this year, 277 new offshore wind turbines, totalling 1,045 megawatts (MW), were fully grid connected in Europe. In addition, 268 foundations were installed and 254 turbines were erected from January to June, according to EWEA. The sector has therefore been performing well. But unanswered questions remain. One area in particular where accurate data has been thin on the ground is that of wind farm wake predictions. This means the effect that the physical presence of wind turbines would have on the flow of the wind and therefore on the output of a wind farm, its energy yield and other elements.

The European Energy Research Alliance (EERA) has decided to act to try to fill this lacuna by joining forces with partners from industry and academia. The result is the EERA-DTOC (Design Tool for Offshore Wind Farm Cluster), which began operating in January 2012 and will run until June 2015. Its goal is to design software models that will improve the tuning and modelling of wind farms.

"There was a call for the EU to come forward with some solutions about how to plan large offshore wind farms more efficiently," explains Charlotte Bay Hasager, senior scientist at the Technical University of Denmark (DTU) and EERA-DTOC project coordinator. One particular issue was that of "missing links" between science and industry and so the fact that eight major companies involved in operating wind turbines have joined the project is great news, says Dr Hasager.

The companies that are involved are: Norway's Statoil and Statkraft; Iberdrola in Spain; Renewable Energy Systems (RES) and the Carbon Trust in the UK, E.On and Hexicon in Sweden, and Germany-based Bard Engineering. In total, 22

The software will calculate the impact of new offshore wind farms on existing ones

partners are involved in EERA-DTOC – the majority are European universities and research institutes, although one exception to this is the University of Indiana in the US, whose trustees are also partners in the consortium. The project is costing €4 million with €2.9 million coming from the EU's Seventh Framework Programme (FP7) and the remainder in match funding from industry.

The ultimate goal is to "deliver a robust modelling tool that we can trust," says Dr Hasager. "For many software, users have to go through a high speed learning curve before they understand a system and it is often easy to make mistakes." She says that the project team wants to "produce software which even if the user puts in pretty weird data, the programme will be able to figure out that a mistake has been made and that the data is out of balance".

Moreover, the team is not aiming to be a panacea to all problems. "Some people would like to create a piece of software that can model anything and everything, but we will be pleased if the final programme will model the most likely scenarios," says Dr Hasager. "We are therefore happy to admit that we plan to omit lots of things," she adds. "Too much software has too many functionalities and then they are not used." In short, "we want a software that gets reliable results," insists Dr Hasager.

The first area for the software to tackle is that of optimum spacing between wind turbines in the same farm. "If the turbines are placed further apart you get more wind, but then you need more cable and so developers have to be able to work out the most cost effective solutions," says Dr Hasager. This question will become even more significant as large arrays of floating wind farms start to appear, which will then have to be connected to the grid structure and the power generated from them integrated into the electricity supply systems.

Secondly, the software will be able to simulate how existing wind farms could impact the efficiency of newly built farms even if there seems to be a fair amount of water between them. "We will try to model this for the first time," says Dr Hasager. "In the past, a developer would have been the only person to put up an offshore wind farm in a particular spot, but now the map is becoming completely crowded in some areas," she explains.

The European Commission anticipated in a 2008 communication on offshore wind energy that "offshore wind can and must make a substantial contribution to meeting the EU's energy policy objectives through a very significant increase - in the order of 30-40 times by 2020 and 100 times by 2030 - in installed capacity compared to today". If this is to be achieved, large amounts of offshore wind farms will have to be built in the coming

Dr Hasager: the new tool will run 20 scenarios with one click

years with clusters of wind farms appearing at favourable locations, like in the German Bight and Dogger Bank off the UK coast.

Moreover, part of the EERA-DTOC project's brief is that it will contribute to the development of offshore wind power as required by the EU's Strategic Energy Technology (SET) Plan, which aims to accelerate the development and deployment of cost-effective low carbon technologies. Agreed in 2010, one of the aims of the plan is the "development of more accurate mapping of wind resources and of capacity potentials in Europe including hostile and complex environments," notably offshore.

These challenges are being dealt with by six working groups and their findings will be presented during a series of seminars and workshops organised by EWEA throughout the length of the project. The first EERA-DTOC workshop took place in London on 6 June 2013 and the next update will be given during a seminar given by the project team on 19 November 2013 in Frankfurt, Germany.

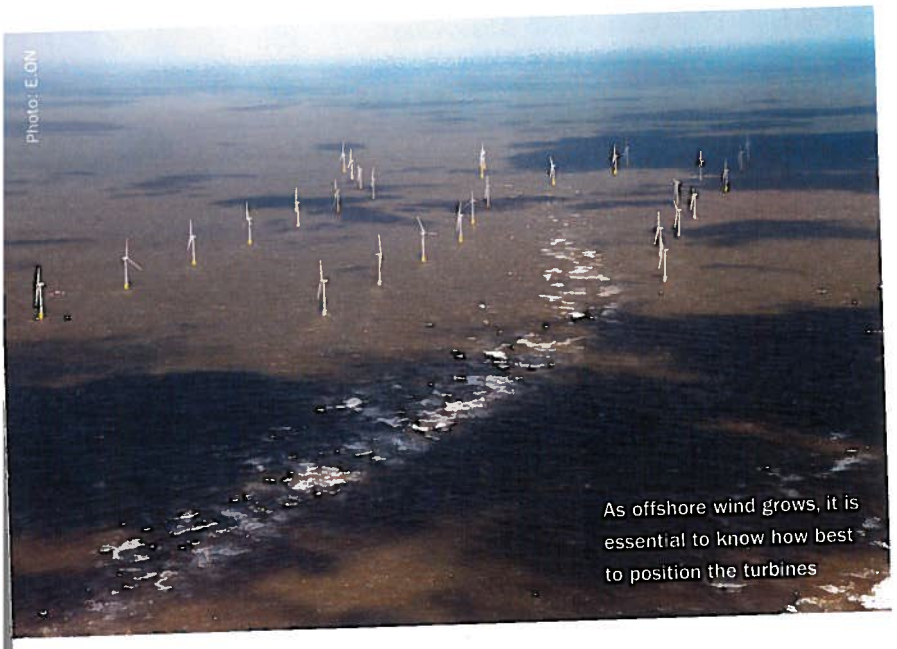
Dr Hasager and her team are now focussed on "integrating the different pieces of software" that they want to put together as a single piece of kit. "We want to avoid a 'copy and paste' process from software to software and instead get information sent directly from one database to the software needed," she says. Because of this slightly more long-winded approach, it will take around two years to fully develop the tool.

The team also wants to add real power production data to the software. "It is always difficult for software to compare power production data as this information is often classified," says Dr Hasager. But she insists that "it is really important to get this data shared". The project will therefore use measurements taken by the Fraunhofer Institute for Wind Energy and Energy System Technology (IWES), one of the partner's in the project. The institute has a ship equipped with light detection and ranging (Lidar) technology sailing around near windfarms to measure the wake and it will feed this data back to the EERA-DTOC team.

After all this information has been collected, the plan is that the software will then "take ten to 20 likely scenarios, run them and compare them," says Dr Hasager. A developer will then be able to take this data and estimate how much power could be generated from different scenarios and at what cost, and which scenario would be best for its business. She adds that the project already has ten wake models that have been compared to datasets for two large offshore wind farms and that "we can now explain how they are behaving".

The final question that will have to be answered before the project is completed is who will be allowed to use the tool and how they will be able to view it. "We still have to decide exactly how access to the tool will be work, but it won't be open access," states Dr Hasager. This is because "there will be some costs involved in running the software as somebody will have to be paid to update information and to help companies run the programme correctly," she explains.

Even if the final tool will be available at a certain cost, this is unlikely to deter developers and others in the wind industry from using it given the advantages it seems set to bring, and the fact it will be offering a unique service. "Nobody can run 20 pieces of software, they get tired just thinking about it, and we hope that with our new product, they will be able with just one click decide exactly which software they want to run," concludes Dr Hasager confidently. ■



As offshore wind grows, it is essential to know how best to position the turbines